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**APPLICATION NUMBER:** *60/516,247*
**FILING DATE:** *October 31, 2003*
**RELATED PCT APPLICATION NUMBER:** *PCT/US04/36542*

**THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS** *US60/516,247*

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Certified by

Jon W. Dudas

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# PROVISIONAL APPLICATION FOR PATENT COVER SHEET

**This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).**

| Express Mail Label No. | EV 342472551 US |
|---|---|

| INVENTOR(S) | | |
|---|---|---|
| Given Name (first and middle [if any]) | Family Name or Surname | Residence (City and either State or Foreign Country) |
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Additional inventors are being named on the _____ separately numbered sheets attached hereto

**TITLE OF THE INVENTION (500 characters max)**
**UNIVERSAL ONE CYCLE CONTROL VECTOR CONTROLLERS**

**CORRESPONDENCE ADDRESS**

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**ENCLOSED APPLICATION PARTS *(check all that apply)***

☒ Specification *Number of Pages* 5 ☐ CD(s), ____

☒ Drawing(s) *Number of Sheets* 0 ☒ Other : Appendix A 32

☐ Application Data Sheet. See 37 CFR 1.76

**METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)***

☒ Applicant claims small entity status. See 37 CFR 1.27.

☐ A check or money order is enclosed to cover the filing fees

☒ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 15-0665

☐ Payment by credit card. Form PTO-2038 is attached.

AMOUNT ($) $80.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency is and the Government contract number is .

*Respectfully submitted,*

SIGNATURE _____ Date October 31, 2003

TYPED or PRINTED NAME Kenneth S. Roberts REGISTRATION NO. *(if appropriate)* 38,283

TELEPHONE 949-567-6700 Docket Number: 703538.4029

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UNITED STATES PATENT APPLICATION
FOR

# UNIVERSAL ONE CYCLE CONTROL VECTOR CONTROLLERS


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# UNIVERSAL ONE CYCLE CONTROL VECTOR CONTROLLERS

## FIELD OF THE INVENTION

[001] The invention relates generally to the field of power converter controllers, and more particularly to systems and methods for universal one cycle control vector controllers.

## BACKGROUND INFORMATION

[002] Power converters are indispensable elements in Distributed Generation (DG) power systems. A power converter such as a power factor corrected (PFC) rectifier or an active power filters (APF) can be used to suppress the harmonics generated by loads present in the DG system. A static synchronous compensator (STATCOM) type power converter can be used to control the power flow in the DG power grid, while a grid-connected inverter can form the key bridge between most of the renewable energy sources and the power grid. In recent years, research and applications of PFC rectifiers, Active Power Filters (APF), STATCOMs, and grid-connected inverters using voltage-source converters (VSCs) have attracted more attention due to the increased energy awareness across the globe. Most reported control methods employ DQ conversion and real-time reference current calculation. These methods require a high-speed digital microprocessor and high performance A/D converters and result in a higher cost, higher complexity and lower reliability.

[003] Prior research has demonstrated that one-cycle control is a unified pulse width modulation (PWM) control method viable in the power electronics field. One cycle control can be analagized to an analog computer, capable of controlling all basic power converters with relatively lower costs, lower complexity and higher reliability. But in each application the detailed control circuits based on one cycle control are different, a fact which results in several different control chips for controlling a three-phase PFC rectifier, APF, STATCOM, and grid connected inverter respectively.

## BRIEF DESCRIPTION OF THE INVENTION

[004] The present invention is directed to systems and methods that allow for the control of a power converter using a three phase, multilevel voltage source converter and a one cycle control methodology. In one example embodiment, a one cycle control voltage source controller is connected to a transitor-based module to implement a power converter, such as a PFC rectifier, an APF, a STATCOM or a grid connected inverter. One of the purposes of the system and methods is to develop simple, reliable, low cost, and easy-to-use power electronics for industrial and power system applications.

[005] Preferably, one cycle control is used to implement a universal control circuit capable of controlling PFC rectifiers, APFs, STATCOMs, and inverters in both two level and three level configurations. The universal control circuit can preferably control multiple types of power converters on a single integrated circuit chip, creating more practical applications for renewable energy and distributed generation and more powerful control functions. The industrial applications can include PFC rectifiers and inverters for motor drives, commercial electronics products, etc. The power system applications can include APF for power quality control, STATCOM for flow control, inverters for renewable/alternative energy power generation.

[006] In addition, the systems and methods described herein provide control key equations and circuits for a one cycle controller controlled PFC rectifier, APF, STATCOM, and grid connected inverter, as well as numerous modulation embodiments for diversifying the range of applications in which the universal control circuit can be applied.

[007] The present invention is further illustrated by Appendix A, which is incorporated herein by reference as if set out in its entirety.

[008] In the foregoing specification, the invention has been described with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention. As an example, each feature of one embodiment can be mixed and matched with other features shown in other embodiments. Features and processes known to those of ordinary skill may similarly be incorporated as desired. Additionally and obviously, features may be added or subtracted as desired. Accordingly, the invention is not to be restricted except in light of the attached claims and their equivalents.

CLAIMS

What is claimed is:

1. A universal control device for controlling a power converter, comprising:

a three-phase multilevel voltage source converter coupled with a control circuit and a plurality of output capacitors, wherein the three phase multilevel voltage source converter is configured to balance the voltage on the output capacitors with one cycle control.

2. The control device of claim 1, wherein the power converter is one of a power factor corrected rectifier, active power filter, static synchronous compensator or a grid connected inverter.

3. A distributed generation power system, comprising:

a universal one cycle control vector controller configured to control a plurality of three-phase multilevel power converters.

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